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July 1984 Vol. 1 No. 2

Second International Conference on Tension in Performance

July 24—27 1983

AUDITORY/KINESTHETIC COGNITION AND CONTROL OF PERFORMANCE ANXIETY IN PIANO PLAYING

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This paper pursues a line of reasoning I only hinted at at the First International Conference in September, 1981: an idea which was not then discussed in detail because it was, for me, still an embryonic notion in need of further consideration. On the assumption that now, I may have become a bit wiser as well as a little older, I dare to share these more fully elaborated thoughts with you in the hope that they may contribute something to our collective understanding of the topic which brings us together here again.

At that first conference two years ago we were enlightened on the subject of stress and its relationship to tension and anxiety, upon the possible role of maladaptable physical structures as sources of tension, on the roots of tension in poor technical approaches, and a variety of other related topics. We were also exposed to numerous valuable ideas on how tension and anxiety might be mitigated and controlled, by means of the Alexander principle, cognitive and behaviour modification, Beta-blockade, and other therapies which would appear to be rich in potential. I myself explored mentation in performance from a psychodynamic point of view—a point of view to which I continue to subscribe, with the minor alterations that inevitably accompany on-going conceptual refinement and growth. It is a point of view I have found impossible to ignore, considering the complex nature of the human being and of the musical act in which he engages.

It occurred to me almost from the start of my research in 1979 that, while behaviour therapy or cognitive-behavioural modification, for instance, might indeed effect a change in the performer's maladaptive behaviour and in his tendency to task-irrelevant ideation, if things were not right in his piano playing, in his sensory priorities, or in his task-related mentation, the maladaptive behaviour and task-irrelevant "self-talk" would surely return in an abundance which would overwhelm him. That, no matter how well-conditioned his body, his coordinative faculties, his "use", (1) or how well-tuned his psychological and physical being, all would likely come "untied" again unless his perceptual channels remained open and functioning appropriately where his performing art was concerned.

I began to seek solutions in the function which I have since labelled one's "auditory-haptic coordination"—a function which clearly must operate efficaciously and reliably at the subconscious level of awareness if the performer is to be freed from the concerns for self, the noisy clock on the wall, or for the music critic who sits somewhere in the audience—a freedom which he must enjoy if musical values are to occupy the centre of his "circle of attention". (2) I came to the realization that the inter-connections which comprise the feedback loop that spawns and maintains performance anxiety must include his cognitive-perceptual priorities and dispositions, as well as his autonomic-physiological adaptations, his estimates of self-efficacy, and his levels of muscular tension; that all, including the player's auditory-kinesthetic perceptual balance, are interdependent, each affecting the other,

each capable, under conditions of high threat or stress, of setting off the chain reaction which we call performance anxiety. Should one of the nodes around the loop be out of kelter, chances are they all will be. If any one of them is in a state of "ill health" ,they might all respond adversely.

While performing, the exertion caused by inordinately tense skeletal muscles may accelerate the heartbeat, deepen breathing, induce vasoconstriction, etc., as it lowers one's feelings of self-confidence, and, in turn draws one's attention toward the kinesthetic experience to an extent that attention to auditory signals is minimized. Inadequate musical/technical preparation, causing low estimates of self-efficacy, may draw one's attention away from the auditory experience, causing one to rely almost totally upon a kinesthetic cognitive style that confuses musical intensity and muscular tension, with manifestations in breathlessness, elevated vascular responses, etc. Or, distrust of one's auditory faculties may cause one to substitute kinesthetic awareness for the auditory experience (with the inevitable confusion of muscular tension and musical intensity that results), the overly-tense muscles causing physiological arousal, which, in turn lowers one's estimates of self-efficacy; and so on, and so on.

Allow me to trace this reasoning from the start so that I may indicate some of the steps that were taken, both theoretically and empirically.

I believe it is apparent that, of the human sensory apparatuses, those which are essential to performing upon any instrument are the haptic (i.e., tactual and kinesthetic (3)) and auditory. Although one may argue that sight is essential, I believe the fact of so many excellent blind performing musicians in music history would indicate that the visual system, while a great convenience, is not essential. And, although various allusions are made to a gustatory and olfactory contribution to performance, usually in jest, I am sure neither really contributes significantly in the practical sense.

Of the two sensory systems, haptic and auditory (or aural), it is obvious that performance on any instrument would be impossible without the former. (Henceforth, I will use the words haptic and kinesthetic interchangeably, in spite of their somewhat different meanings). In fact, without kinesthetic involvement, one would be just as incapable of walking, eating dinner, or scratching his head, as he would be of playing the piano.

But what of auditory involvement? I personally believe, that the degree of aural participation in the act of performance is the critical point at issue here. Discounting for the moment the young organist, born deaf, who is presently pursuing a degree in music at Oxford, empirical tests which I have performed at the University of British Columbia have shown that, indeed, a well-practised performance from memory can be done (and often is done) without benefit of auditory feedback. The absence of auditory feedback does not preclude the likelihood of internally-produced auditory images, however. I have not as yet found a way of eliminating that possibility, experimentally. I propose, nonetheless, that the degree to which pianists can and do internalize sonorous images, is a highly significant variable. Some apparently internalize music totally, with great clarity and precision, while others are less capable of doing so.

The experiments to which I allude were begun prior to the last conference and completed subsequently. The first had to do with performance from memory without benefit of auditory feedback. I shall not detail the method at this point (as I did two years ago). Should anyone be interested, I will be glad to explain it during the discussion period that follows, time allowing.

The twenty-four subjects for the experiment were all pianists of considerable accomplishment. Twelve possessed absolute pitch and twelve did not. They were all asked to play, without auditory feedback, a work which they selected from their current performing repertoire. The twelve with absolute pitch experienced no difficulty whatsoever. Of the twelve without absolute pitch, only a few minor difficulties were detected (4).

In the second phase of the experiment I asked each of the subjects to name works in his repertoire which he had neither practised nor performed for over a year. (I deliberately avoided telling the subjects ahead of time that this would be done, for obvious reasons). I selected from among the pieces that were named and requested each subject to make every effort to play the piece that I had chosen, without auditory feedback, from beginning to end. As I reported in 1981, of those with absolute pitch, only one or two of the younger subjects (who, incidentally, were not practised improvisers) experienced any difficulty. However, of the twelve without absolute pitch, only one could find his way to the end of the piece; the rest had difficulty playing beyond the first phrase or two. Significantly, the one who was able to play almost flawlessly through to the end is known for his considerable expertise in improvisation.

I have derived a considerable number of implications from this experiment. Some of them are quite apparent I believe, so rather than discuss them at this time, I would prefer to leave you free to consider whatever conclusions you might reach. Perhaps they may be discussed later.

A second empirical study brought out a number of interesting implications, as well. However, I will defer expository comment on it also to the discussion period when I will perform the experiment all over again with you as my subjects.

One of my colleagues, an audiologist and speech scientist (who admits to knowing nothing about music) insists that auditory feedback is totally unnecessary in piano performance, an extreme view with which I disagree, as you will observe. Needless to say, he took great delight in the results of my "flying-deaf" experiment, as it seemed to lend credence to his point of view. As one might expect, he was not in sympathy with my argument that most musicians hear the music "in their heads" as well. He also points with delight to the well-publicized instance of the Oxford student as a case in point. It is hoped that we may sort out this issue in the forthcoming year during which we will conduct, in tandem, an on-going seminar on the subject of musical perception.

While one must assume that the act of performance may be possible without listening (i.e., if it is "practised in" sufficiently), a state of affairs frequently noted in the literature (5), it is not characteristic of the kind of

high-level artistry I have in mind—an artistic ideal which most of us know and to which we aspire both as performers and teachers. I am convinced that most individuals outside musical performance usually do not appreciate the difference, so it is understandable for them to assume that every performance proceeds on "automatic pilot", without conscious effort.

I see the amount of auditory participation in performance as the critical point, however—a leading factoral determinant not only in the level of artistic achievement, but as well, in the degree of self-efficacy experienced by the performer. I see it as a significant variable which, as often as not, is indicative of the degree of anxiety that may be experienced by the player.

In my view the performer's auditory system, at its best, not only serves as the single most reliable measure of musical values (i.e., those that are actualized through the instrument), but, at the subliminal level, adjudicates pitch and "chunk" recall, in a monitorial and confirmatory capacity, which when coordinated with one's haptic system, assists as well, in the location of the notes that correspond to those notes and "chunks". It has been my observation that the accomplished pianist, who has explicit trust in his auditory faculties, consciously "listens to the music" (i.e., to musical values) while "hearing the music" (i.e., its pitches and, to some extent, its structural Gestalt) below the threshold of conscious awareness (6). Furthermore, I believe it is apparent that, as frequently happens, when the pianist distrusts his auditory processes, neither of these functions is fulfilled.

At worst, when justifiably or not, the performer has little or no faith in the reliability of his aural faculties, he relies almost exclusively upon kinesthetic perception for "note-location-recall", and "flies deaf" where musical values are concerned under the false impression that his musical intentions are faithfully reflected in his kinesthetic experiences. It is the ultimate in unwitting self-deception and, I maintain, one of the most common of performance ills. Why is it so often committed?

I am convinced that the primary reason for an auditory-haptic imbalance, that is, one that is acutely slanted toward haptic channels, is low confidence in aural perception. I am also convinced that, notwithstanding genetic predispositions which clearly cause higher pitch acuity in some individuals than others, much of the low confidence exhibited by young pianists is a result of their early musical experiences—musical experiences which glorify the eye and the sense of touch at the expense of the ear. But that is an issue much beyond the limits of this paper. The fact is, nevertheless, that many young musicians reach the age of nine to twelve years of age with little or no confidence that their auditory systems will serve them in "note-location-recall". As a consequence, their auditory perception is ill-coordinated with their haptic system and of little use to them musically, with the result that (as indicated earlier), "when the chips are down", their auditory channels are blocked off in deference to the kinesthetic experience.

When I speak of pitch acuity I am not referring necessarily to absolute pitch, as advantageous as is that faculty in most types of musical performance. Needless to say, there are many fine pianists who have excellent ears but not absolute pitch. Almost invariably, however, where such pianists do not have

absolute pitch, they have coordinated whatever pitch discernment they do have with their haptic systems, accepting it as an integral part of the sensory team, where it functions reliably and efficaciously. Frequently, as I will have occasion to mention again, they are pianists who are confident extempore players.

Theories of Absolute Pitch

The question of absolute pitch is now receiving a great deal of attention and a number of interesting theories have emerged in recent years which augur well for future understanding of the "phenomenon".

Perhaps one of the most elegant theories of absolute pitch is that postulated by Arnold Schultz. He suggests that the person with absolute pitch has learned to associate pitch with a stable source outside himself (often the piano)—a source to which all pitch is referred reflexively. He theorises that the person without absolute pitch, to the contrary, refers pitch to his own vocal apparatus (a very unstable pitch source, obviously) via innervations that accompany awareness of, and attempts to identify, pitches (7). It is a theory which makes a great deal of sense, upon reflection, going a long way toward explaining this controversial phenomenon. Supporting experimental evidence is still needed, nonetheless.

Schultz does not offer an explanation for how these individual differences come about. My own explanation, which may appear sophomoric to some but logical to others, is that, like many other human predispositions, it is a result of genetic programming (perhaps a genetically—determined biochemical characteristic at the sub-synaptic level) which causes one human organism to be more receptively aware of the sonorous environment than others: that which I have come to regard as a predisposition to auditory stimuli. This theory, too, awaits scientific confirmation—a hypothesis which must defer to the laboratory. I will continue to hold to this explanation, nonetheless, until such time as it is overturned by one that is more convincing.

On the supposition that my theory has some validity then, if a future musician should arrive on this earth with such an auditory predisposition and during his earliest years, be surrounded by the appropriate auditory stimuli, he may very well develop an associative memory of pitch, i.e., absolute pitch. According to Dr Eizo Itoh (of the Yamaha Music Foundation), this would be most likely to occur between the ages of three and eight years of age, the likelihood declining sharply thereafter(8). There is the possibility, one might conjecture, that the appropriate genetic predisposition may be activated even before the age of three, provided the auditory environment is favourable—that is, should the auditory environment be sufficiently enchanting to engage the awareness of the very young child.

It can be assumed I believe, that pitch acuity leads to auditory confidence and that habitual reliance upon auditory information-processing in tandem with haptic information-processing is a natural biproduct of their coordinated use. On the other hand, the absence of pitch acuity—or what is **assumed** by the player to be unreliable aural perception—leads to a mistrust of auditory information-processing and as is to be expected, a failure to

coordinate the auditory and haptic systems. Whether one's auditory faculties are inherently weak, or whether, by dint of one's early musical experiences, priorities have been merely misaligned, is a question which is difficult if not impossible to answer at this stage of our knowledge. It is probably very likely that, as I have implied earlier, genetic factors order cortical structures in such a way as to predispose some individuals more acutely to auditory stimuli than others. It is equally possible, on the other hand, that in many individuals, auditory awareness may be dormant and functionally untapped, rather than weak or non-existent, due to their early musical experiences—a very good possibility which, as I am a teacher, gives me unwavering confidence that steps can be taken to awaken auditory processes and to coordinate them with kinesthetic cognitions.

A corollary of pitch perception, I believe, is the ability to image pitch: i.e., the ability to "hear" musical sound internally (whether relatively or absolutely). Most individuals can image a melodic line (i.e., a linear succession of pitches), if only the few notes of a familiar tune; and usually, even musically-untrained people can externalize, by one means or another, a melodic idea which they are able to internalize. Surely, the ability to image, retain and reproduce linear successions of pitches is essential for any performing musician. One would assume so, at least; however, it is this skill which, surprisingly, many young pianists fail to utilize to advantage. Losing the thread in performance, both auditorily and haptically, is a commonplace.

It is equally important, I am sure, for most pianists (if not all musicians) to have recourse to the auditory imagery of chords and harmonic intervals, to be able to retain them in memory and reproduce them coordinatively. However, I would suggest that more pianists than not fail to fulfill this need with the result that the harmonic structures in the music they play remain outside of their field of auditory awareness, especially when "under fire". While enough awareness may be retained of a sonority to indicate when it is **wrong**, not enough is present to function affirmatively in a coordinated action with the kinesthetic system.

Hearing the music and **listening to** the music then, imply two distinct cognitive strategies. Hearing the music, a function that is greatly facilitated by high pitch acuity, can and does go on outside of awareness during performance. Listening to the music, on the other hand, involves conscious attention. For the pianist with habitual faith in his auditory processes, neither of these strategies present any real problem, even when encountering what he perceives as a threat to his performance (a perception which is most often greatly reduced by his auditory confidence). As noted, on the other hand, lacking confidence in his ability to perceive with auditory discernment, he may likely abandon auditory cognition when threat is encountered. While the pianist with absolute pitch may occasionally demonstrate insufficient key control by dint of too little concern for the role of the haptic system (a problem which I have called an "inverted auditory-haptic imbalance"), and may forget to **listen to** while **hearing** the music, his problems are minor where note-location-recall are concerned: perhaps the major concern of the pianist with low aural confidence.

The question ultimately arises: Does an auditory-haptic imbalance cause anxiety, or does anxiety cause the auditory-haptic imbalance? It is the old "chicken or the egg" question again. I am sure that which causes which is of less importance than the fact of the potential imbalance itself—an imbalance which, I am convinced, comes about more often by misaligned sensory priorities in musical experience than by genetic sensory deprivation; and under the circumstances, I believe that steps can be taken to reorder sensory priorities even after they have been misaligned. Permit me to mention just a few of the measures which have proven successful in my career as a teacher and performer.

On Vitalizing the Auditory Experience

The more nearly one can identify with his sound source and can make the instrument an extension of himself, auditorily and kinesthetically, the freer he can be from the internal doubts which help to spawn and maintain performance anxiety. That is the ultimate objective of these exercises.

Keyboard Harmony and Analysis at the Keyboard. Daily practice of progressions in all keys, without visual symbols or notation (block and figured chords), together with "skeletonizing" the harmonic structures of repertoire being studied (without score).

Playing by Ear. It is difficult for someone who has never played by ear to do so, especially when years of inhibition have accrued as a result of its avoidance. But anyone who is in the least musical can start by playing a familiar tune (perhaps his National Anthem), even if only with one hand. Harmony, which can grow out of keyboard harmony practice, can be added later, etc., etc. Try it first where it can be certain no one else will hear.

Free Improvisation/Extemporaneous Creativity. What has happened to the habit of "exploring" the music that the piano can make? What has happened to the pleasure that can be derived from allowing the ear and the hands to discover music that is intended only for the "here-and-now"? Perhaps masterpieces may never come to light by these methods, but no end of other benefits will.

Transposition by Ear. Transpose any piece that is in your repertoire without recourse to the music. Start with easy things and very gradually increase their difficulty. It takes courage and patience, but little by little, the ear and musical self-esteem will grow.

Learning New Music by Ear. Record a number of little-known keyboard works on cassette tapes. Start with very easy things (only unaccompanied tunes) and gradually increase the difficulty. Have the subject learn one each week. Try it on yourself, as well. Instead of studying the next new work with score, try learning it from a recording.

Retrieving Old Repertoire without Score. Rediscovering works from one's repertoire—works that have not been played or practised for years—without recourse to the score. The practice is very revelatory. Be patient.

Practising on a Silent Keyboard. Many years ago Lilias MacKinnon bemoaned the demise of the "dumb" keyboard, speculating that it might still be a good way of learning to internalize the music (9). Such keyboards are still available (although not common) and so long as every effort is made to image the sound of the music, not allowing the exercise to deteriorate into a pure kinesthetic experience, it works well. After all, innumerable organists have learned their postludes on silenced organs during long sermons.

Playing Ensemble Music. And last, but certainly not least, the budding virtuoso can often have his ears "turned on" by playing with other players or with singers, particularly in roles where he must adapt rather than be adapted to.

My list of "musical therapies" does not pretend to be exhaustive; far from it. However, these have been effective for me. I will continue to delight in new and better ways that may be shown to me. Please let me hear from you.

References

(1) "Use" in the sense outlined by Barlow. . Wilfred Barlow, *The Alexander Technique* (N.Y.: Warner Books, 1973).

(2) Constantin Stanislavski, *An Actor Prepares.* Trans. Elizabeth Reynolds Hapgood (N.Y.: Theatre Arts Books, 1948), pp. 77ff.

(3) I use the word haptic to include both the kinesthetic and tactual senses, as does S. Howard Bartley, "What is Perception?" In Daniel Goleman and Richard J. Davidson (eds.), *Consciousness: Brain, States of Awareness, and Mysticism* (N.Y.: Harper and Row, 1979), p. 35.

(4) In one instance, a highly-talented young pianist played the entire recapitulated closing section of Mozart's K. 333 (I) with her left hand in the tonic but with her right hand in the dominant. Of course she did not do that when she later repeated the work with auditory feedback.

(5) For instance, see the description in Donald E, Norman, *Memory and Attention.* Second edition (N.Y.: John Wiley and Sons), 1976), p. 210.

(6) Matthay makes a similar distinction between "listening to" and "hearing" the music. Tobias Matthay, *Musical Interpretation* (Boston: Boston Music Co., 1913), p. 5.

(7) Arnold Schultz, *A Theory of Consciousness* (N.Y.: Philosophical Library, 1973), pp. 100f.

(8) Personal communication.

(9) Lilias MacKinnon, *Music by Heart* (London: Oxford University Press, 1938), p. 107.

STAGE FRIGHT: CHARACTERISTICS, PHYSIOLOGY AND THE ROLE OF BETA-SYMPATHETIC RECEPTORS IN ITS MODIFICATION

Thomas A. Brantigan **Charles O. Brantigan**

> Every affection of the mind that is attended with either pain or pleasure, hope or fear, is the cause of an agitation whose influence extends to the heart . . . *W. Harvey, Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus,* 1628. (1).

Stage fright is an ubiquitous process which at one time or another, affects everyone. For most people it is but a nuisance, but for the professional performer it may be disabling, leading to drug or alcohol dependency (2) or loss of career. To society it means the loss of the services of many talented performers. Although within the past ten years, the magnitude of the problem has been described, its physiology and biochemistry understood and effective modalities of treatment described, few musicians, few conservatory students and even fewer physicians are aware of the ramifications of this work.

Anxiety during performance takes many forms (3), some appropriate and some inappropriate. Reactive anxiety, adaptive anxiety and morbid anxiety all may affect a performer. "Reactive anxiety" is tension appropriately caused by inadequate preparation of lack or skill. "Adaptive anxiety" is better described as the excitement of public performance. It is "being up" for a performance and adds the lustre and brilliance which often seem absent in the practice room. It is as though "adaptive anxiety" allows the performer to communicate his own excitement to the audience.

In contrast to reactive and adaptive anxiety, which serve a valuable function, "morbid anxiety" leads to disability. Tyrer and Lader (4), and other investigators have arbitrarily divided this broad disorder into the overlapping categories of neurotic and somatic anxiety. In "neurotic anxiety" the disability originates primarily in the central nervous system. It is primarily psychologically based, leading to mental and emotional paralysis and secondarily, to physical symptoms. "Somatic anxiety", on the other hand, originates primarily outside the central nervous system. It is an end organ response to sympathetic stimulation. In this form of anxiety, emotional problems occur secondarily. The performer thus affected will be physically rather than psychologically disabled. Somatic anxiety is the main problem faced by the professional musician.

In spite of public descriptions of the problem by prominent performers in the lay press, it is widely believed that stage fright is a sign of immaturity in a performer(5). Experienced musicians will insist that although it is important to be well prepared for the performance, both in music and situation, experience, exposure and skill are not protective against stage fright. Stage fright may affect the virtuoso at La Scala as badly as it affects the housewife singing a solo at Dundee Church.

Aside from well known anecdotes concerning such prominent musicians as Claudio Arrau, Vladimir Horowitz, Peter Tchaikovsky and Pablo Casals, there is little objective information about the magnitude of the stage fright response in experienced musicians. Heart rate has proven to be a valuable index of somatic response of stage fright. Thus some inferential information about the magnitude of the response is available in the studies of the effect of beta blocking drugs in professional musicians in which pulse rate or inventory of catecholamine induced symptoms has been studied. The study of Liden and Gottfries (6), for example, involved a "professional symphony orchestra". The studies of James et al (2, 8) have involved professional musicians, and our studies (9) have involved professional musicians from the New York City area, including members of the New York Philharmonic Orchestra. Pulse rates in excess of 180 have been documented in such experienced professional musicians during performance.

We had the opportunity to simultaneously study four internationally known musicians and four students performing a Mozart Octet at the Eastman School of Music. The performance took place as part of a regular concert series in the evening following an afternoon rehearsal. Professionals and students met with the investigators before the rehearsal and were connected to Holter monitors. Monitoring was carried out for a continuous period of six and a half hours, including prerehearsal, rehearsal, post rehearsal, performance and post performance. Average, maximum and minimum pulse rates were recorded each minute for subsequent analysis. Subjects were asked to rate their degree of stage fright on a scale of 1 to 100 after the performance.

Monitoring was successfully carried out in three professionals and four students. The pulse changes in the students were the same as those of the professionals (Figure 1). Considering each time period individually, standard deviations and variences were calculated for each group. There was no consistent difference between the variences of professionals and students which would suggest any cardiovascular adaption as a result of experience and training. Overall, the professionals rated their degree of stage fright higher than did the students. Other Holter monitor responses summarized in Table 1 confirm Taggert's observations of cardiac rhythm disturbances associated with stress (10) and our previously reported observation that musicians are often not sensitive to their own physiological reactions(9). They recognize that they are experiencing stage fright, but not that they are shaking or that their heart is racing or beating irregularly.

There is compelling evidence that the syndrome affecting students and professionals alike is caused by an activation of the sympathetic nervous system known to physiologists as the "fight or flight reaction". This response from a teleological standpoint, is designed to strengthen the organism's defences against various dangers in the environment, such as extremes of temperature, attacks by enemies, and blood loss. Although critics may be perceived as enemies and audiences may thirst for blood, the fight or flight reaction is inappropriate in the context of musical performance. It prepares the performer for sudden physical effort rather than the fine psychomotor coordination required for good performance.

The fight or flight reaction is mediated by catecholamines and their stimulating effects on the beta receptors of the sympathetic nervous system. Stage fright has the same biochemical manifestation (11). Excess circulating catecholamines have been documented when measured in public speakers (12) and race car drivers (13). Secondary rises in fatty acids and triglycerides have been observed as well and may have implications in atherogenesis (14) in people in high stress occupations. Studies by Liden and Gottfries (6), James et al (7,8) and Brantigan et al (9,15) have demonstrated that drugs which block beta receptors produce a dramatic decrease in the somatic manifestations of stage fright. Brantigan et al(9) have demonstrated that the beta stimulating drug terbutaline even though it is relatively selective for beta-1 receptors, increases stage fright. These beta receptor effects appear to be mediated by receptors outside of the central nervous system. The symptoms induced by beta-receptor stimulation are interpreted as anxiety by the central nervous system which in turn leads to a more active sympathetic discharge and more physical symptoms. The somatic anxiety which we call stage fright actually represents self-poisoning!

Although the presence of beta adrenergic receptors in the central nervous system has been documented both biochemically and physiologically (16) and some beta active substances, such as propranolol, do cross the blood brain barrier (17), we believe that the effects occur peripherally rather than centrally. Stage fright symptoms can be both produced and blocked by peripherally acting drugs. Particularly when administered with the proper external cues, catecholamine infusion can produce all of the symptoms we associate with stage fright(18). Administration of adrenalin (which does not cross the blood brain barrier), or the presence of a pheochromocytoma, can cause anxiety (19). Beta blocking drugs which do not cross the blood brain barrier, such as practolol (20), have been just as effective as drugs which do, such as propranolol, in treating somatic anxiety. Conversely, doses of beta blocking drugs of orders of magnitude larger than those used in stage fright are required to treat neurotic anxiety (21).

Some musicians truly do not have stage fright. Asthma researchers have recently identified a subgroup of patients who have antibodies to beta receptors. Not only have they measured these antibodies, but have also shown that these patients have a lowered responsiveness to beta stimulating drugs than do patients without the antibodies. Fraser et al (22) concluded that "autoantibodies to beta-adrenergic receptors may play a part in the development of certain autonomic abnormalities . . ." We are tempted to speculate that one of these autonomic abnormalities may be lack of stage fright.

Although performance anxiety represents a complex mix of the physiological and the psychological, our experience with professional musicians indicates that the concept of stage fright should exclude "reactive anxiety" and "adaptive anxiety" and include only "morbid anxiety". While neurotic anxiety certainly may be important in some people, our experience with professional musicians indicates that somatic anxiety is the major component, and that psychological problems are secondary. This somatic anxiety affects most people to some degree, and some to the point of incapacitation. Experience is not protective, as professionals and students have the same response. The syndrome is chemically mediated.

We would like to consider several modalities of therapy to try to define their role in the treatment of stage fright based on our own experience. Traditional efforts at treatment have emphasized the psychological aspects of the problem and have hoped to reap a secondary physical benefit. Our approach using the beta blocking drugs has effectively eliminated physical symptoms in an inexpensive way, hoping for a secondary psychological benefit.

Musical Analysis Training, or the teaching of musical technique and interpretation, we consider mandatory in any treatment modality and do not consider stage fright to be a problem until it is refractory to such intervention.

Cue controlled relaxation involves training in progressive muscle relaxation, after which the subjects are given a cue word. The subjects are taught to pair this cue word with the relaxed state in such a way that they are able to instruct themselves to relax while playing music.

Cognitive restructure involves the identification of self-defeating thought patterns (Figure 2). These are analyzed in terms of their consequences including distraction from the task at hand and accelerating anxiety, both of which lead to increased sympathetic stimulation. Coping statements are substituted which diminish debilitating anxiety.

Our early research in stage fright involved the same principles currently used in cue controlled relaxation and cognitive restructure, although we were unfamiliar with those specific terms (23). During five sessions, subjects, selected both for stage fright and susceptibility to hypnosis, were taught self hypnosis and relaxation techniques. During the hypnotic trance, the subjects were completely awake and alert and in full command of their faculties. They were given a cue to assist in the process of relaxation, a touch on the shoulder administered initially by the investigators and eventually self administered. In addition to relaxation, the hypnotic trance was used to alter self defeating thought patterns. No attempt was made to identify thought patterns specific to the individual, but subjects were taught not to verbalize (Figure 2) during performance. An attempt was made to structure perceptions of performance: "Performance is a pleasure; The audience came to hear you play; You are comfortable with your preparation; You have unshakable confidence; The thought of performance makes you smile".

The results of this approach were similar to those recently reported for cue conditioned relaxation and cognitive restructure(3). Anxiety was lessened in 100% of subjects and artistic improvement occurred in 64%. Unfortunately although somatic symptoms were improved, they were not improved in a clinically significant way. It seemed as if the anxiolytic effect was produced by restructuring the subject's thought patterns so that he perceived sympathetic hyperactivity as pleasure rather than as stage fright. In subjects who are physically disabled this approach would not be of much benefit. In addition, maintenance of skills required continuous practice, and many subjects were not candidates for such hypnotic restructuring. In our perception, the biggest problem with this early approach was that we could teach relaxation and give the subjects the experience of relaxation under hypnosis and reorder their thoughts, but we could not give them the experience of performance without the sympathetic bombardment which they had come to expect.

Since they were never able to experience what a controlled performance felt like, they were never able to learn to control their sympathetic responses. As a result, physical symptoms eventually led to a breakthrough, overwhelming their training. For these reasons continued practice was required and the system on occasion broke down without warning. The same problems probably exist with current attempts at cue controlled relaxation and cognitive restructure.

We believe that the beta blocking drugs have one subsidiary role and two main roles in the treatment of stage fright. The subsidiary role is the most difficult to define and involves the continuous use of these drugs in established musicians whose career is in jeopardy. In patients who have another medical indication for the drug, such as hypertension, the choice is easy. The decision to use these drugs continuously and to accept the potential problems which may arise, without other indications is more difficult. On the other hand, most performers are, at times, faced with isolated episodes of severe stress in performance (such as a symphony audition) where the situation is not even analagous to their usual performance (section violin). Under these circumstances use of beta blocking drugs is indicated. Beta blocking drugs should also be used to fill a gap in the current psychological approaches to stage fright.

Acknowledgements: The authors would like to thank John DiCamilla of Northeastern Scanning, Rochester, New York, for his help with data collection and analysis for the Eastman study, and to Robert Freeman, Director of the Eastman School of Music for making it possible.

TABLE 1:

Professionals, Students and Mozart's Octet:

A comparison between four students and four professional musicians playing a Mozart octet.

Subject	**Medical History**	**Pulse/Anxiety (Performance)**	**Observations**
BP 66 M	Ulcer history	Maximum 150 Average 132 Anxiety 100	Rate related ST elevation Sinus tachycardia
DH 21 F	Negative	Maximum 161 Average 129 Anxiety 75 Visible shaking	Sinus tachycardia Trigeminy 2/min. 4/1 minute. multifocal PVC's
PF 66 M	Obstructive lung disease, norpace and peritrate	Average 113 Anxiety 100	Sinus tachycardia

LL 25 M	Negative	Maximum 125 Average 118 Anxiety 30	Sinus tachycardia
RA 66 M	Coronary bypass on nitrates	Maximum 148 Average 127 Anxiety 100	PVC's, Early prematurity index, Sinus tachycardia
DS 22 M	Negative	Maximum 161 Average 129 Anxiety 40	Sinus tachycardia
SS 66 M	Negative	Anxiety 10	Monitoring equipment failure
MH 21 F	Negative	Maximum 185 Average 114 Anxiety 90	Sinus tachycardia

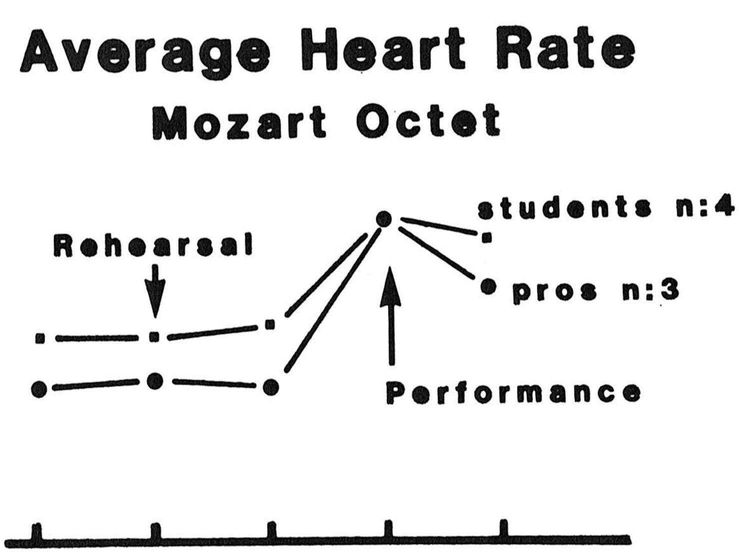

Figure 1: A comparison of the average heart rates of professional musicians and students performing a Mozart Octet at the Eastman School of Music.

Figure 2: "Verbalization". An actual example of a self-defeating thought pattern of a tuba player performing the Verdi Requiem (purged of profanities).

"Oh, no! It's only 10 measures away. I'm nervous.
I'll probably blow it.
I missed it in 2 out of 3 rehearsals.
Six measures away.
I know I can do it.
I've got to relax, but it's probably too late.
Three measures away!!!
Maybe I should aim Higher than usual.
No, don't do anything different.
I blew it!!!
What will the trombone players think?
Calm down and get the next one.
I got it!!!
I knew I could do it.

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MENTAL REHEARSAL FOR MUSICIANS: THEORY, PRACTICE AND RESEARCH

Evelyn I. Bird

Every performer desires replicability of technique from practice to performance times. One method of augmenting performance enhancement is to mentally rehearse those skills. The terms mental rehearsal/mental practice/mental training are defined as the cognitive rehearsal of a physical skill in the absence of overt, physical movements (Magill, 1980). The study of mental rehearsal has developed in the fields of psychotherapy and the learning and performance of motor skills. This paper deals mainly with the latter field which has three aspects: the acquisition of motor skills, the performance of a well-learned skill and the retention of the skill. The majority of the research has been on the role of mental rehearsal in skill acquisition. In general, the results of the investigations in skill acquisition have shown that mental rehearsal is better than no practice at all, although, not as effective as actual physical practice. More importantly it has shown that a combination of mental and physical practice is as good or better than physical practice only (Richardson, 1967) (Corbin, 1972) (Magill, 1980). An early example of a music study combining mental rehearsal and piano practising was conducted by Rubin-Rabson (1942). She found that a mid-way period of mental rehearsal proved reliably superior to other five minute periods placed before or after keyboard trials to a criterion. Mental rehearsal not only reduced the required keyboard trials but achieved retention as good as that offered by extra keyboard trials. Retesting to criterion showed that little more skill was lost after seven months than after two weeks and that the less able learners retained less than the more able. These findings coincide with current principles of the learning and teaching of motor skills, therefore, everyone who is involved in motor skills whether it be music, dance or sport has a common basis of communication.

Uses of Mental Rehearsal in Music

Learning and using mental rehearsal is closely associated with relaxation as it is suggested that a relaxed state, particularly for a beginner, enhances the vividness of the imagery. Very little research has been done to test this hypothesis (Heil, 1982) but based on empirical evidence it is recommended that in developing the musical applications of MR, relaxation be incorporated. Mental rehearsal would seem to enhance performance in at least seven categories:

1. Learning a new piece of music which involves memorizing, discriminating cues such as feelings and tones and the focusing of attention;
2. Making the skill automatic which involves correct repetition, the gestalt feeling and precise timing;

3. Detecting and eliminating errors since the performer is not always aware of errors while attending to the production of an unbroken rhythm;
4. Role playing and desensitizing stressful and emergency situations such as stage fright and broken strings;
5. Developing positive feelings which will promote self-confidence and optimal arousal levels for a peak performance;
6. Continuing to learn when the musician is injured and unable to physically play or when too fatigued and muscles need to rest;
7. Saving financially when piano rental or orchestra rehearsal time is expensive.

Teaching Mental Rehearsal

The following should be considered in teaching mental rehearsal:

1. MR appears to be more effective if the individual first becomes relaxed;
2. The person who has a degree of initial skill seems to benefit the most from MR;
3. At least one rehearsal should precede the performance;
4. Use as many sense organs as possible when rehearsing: sound, emotions, sights, etc.;
5. In general, the tempo and total time for the music should be the same in MR as for the actual performance;
6. Mentally go to the site where the music is to be performed;
7. Do the selection in its entirety, if not possible, do enough to keep the rhythm intact;
8. The performance should be "a perfect execution";
9. Obtain as much clarity of the setting and the performance as possible;
10. The MR should be as specific as possible;
11. Believe that the performance can be perfect;
12. The number of MR repetitions necessary is unknown but over-learning is recommended.

Effectiveness of Mental Rehearsal

Various theories have been proposed to explain the effectiveness of mental rehearsal. The psychoneuromuscular explanation postulates that during mental practice the individual is actually producing electrochemical charges in the muscles that are used in the physical movement. Associated

sensory feedback is also produced which allows the person to make appropriate corrections for the next attempt (Richardson, 1967) (Magill, 1980). Feltz and Landers (1983) in their analysis of research on MR note that the psychoneuromuscular theory is difficult to evaluate because so few experimental studies have considered MR as an independent variable with electromyography as a dependent variable. They noted that studies by Jacobson (1931), Schramm (1967) and Suinn (1980), which reported EMG activity during mental rehearsal of motor skills, were inadequate because they did not quantify the muscle activity.

Another possible explanation for the effectiveness of MR is related to learning and memory theory. It is suggested that MR can help the learner answer some of the questions which characterize the early or "cognitive" stage of learning and in later stages it may aid in consolidating strategies and correcting errors. Mental rehearsal may also facilitate the storage of the movement in memory and retrieve the skill from long-term storage (Magill 1980).

A third explanation is that MR assists the performer to psychologically prepare for the skill to be performed. The performer prepares for action by optimizing the arousal level which facilitates reaction time and focuses attention on the task (Feltz and Landers 1983). Portions or all of these explanations may be correct for certain types of tasks, under certain conditions with certain people but much more research is required to develop a clear-cut theory.

The Process of Mental Rehearsal

Individual human behaviour, for example, a musical concert, consists of three stages: the stimuli which initiates the action, the process within the mind and body which interprets and initiates the response and the performance or outcome. As previously mentioned, MR and performance have been shown to have a very positive relationship and the psychological aspects of stimulus reception and learning have been extensively studied. However, little is known about the psychophysiological process of MR. The refinement of physiological equipment and data collection during MR was the first step and then it was shown that the body made characteristic responses during different types of MR, for example, the body responded differently for stressful than for pleasant events. Now the patterns of response and identification of the critical events which elicit these responses must be specified (McGuigan and Pavek, 1972). Also the levels of capacity for mental rehearsal need to be ascertained and then teaching techniques to enhance performance improved (Singer, 1981).

Early work by Jacobson (1927-32) showed that extensive muscle activity occurred when physical skills, such as playing the piano, were mentally rehearsed. Shaw (1938) measured moderately strong muscle responses distributed throughout the arms and legs while imaging the singing of a song and the playing of a wind instrument. No other studies on the muscle response of the MR of music seem to have been conducted. Studies by Lang (1977) and Hale (1981) found that internal or kinesthetic imagery created higher levels of somatic response than did other types of imagery such as

external imaging yourself doing the skill. Kohl et al (1983), investigating the ability to learn to control mental images in a fine motor task as a function of successful performance, concluded that initially most subjects' images were widely discrepant from the actual tasks. However, it was found that the subjects could be trained and the greater the similarity in the timing of the image to that of the actual task, the greater the transfer to actual performance.

Research Study

The purpose of this study with the symphony conductor was to explore the use of electromyographic (EMG) response as a measure of mental rehearsal. If the EMG was indicative of actual performance, it ultimately could be used as a training technique for optimizing performance. The first step was to quantify the EMG response to determine (a) how much increase occurred in EMG levels between a relaxed state and the MR state, (b) if the configuration of the EMG profile replicated that of the music and conducting, (c) the influence of different MR tasks upon the muscle response and (d) whether or not an experienced conductor could mentally rehearse a selection at the same speed as the actual performance. The subject for this study was a very experienced conductor who believed he was a vivid internal imager, who reported using mental rehearsal and imagining the musical tones from a page of music. The conductor was selected as a potential criterion for optimal mental rehearsal in symphony conducting. His EMG performance would then serve as a model in the MR training of neophyte conductors. The EMG data was recorded through silver-silver chloride surface electrodes placed on the upper right arm of the conductor, collected by an Autogen 1700 EMG unit and stored in an Apple II computer. The data was collected every 5 sec. Concurrent body surface temperature and EEG frequency were collected but are not reported in this study. In the laboratory the subject relaxed for 6-10 min. and was then asked to imagine himself conducting the Overture to Die Fledermaus. The following conditions were investigated: (a) actual conducting, (b) MR of conducting with taped music, (c) mentally hearing the music from the score and (d) MR of conducting from the score. Three months later, after conducting eight other concerts, the following two decay conditions were measured: (e) MR with no music or score and (f) MR with music. Table 1 shows the mean values during each condition, the per cent increase of EMG during MR over relaxation levels and the length of time consumed under each condition. The mean EMG level during the actual conducting of the Overture was 9.3 mV which is nearly double that of any MR or covert condition. Condition (b) elicited the greatest EMG response over baseline of any MR condition: a 300 per cent increase. MR of conducting from the score created a 96 per cent increase, followed by conditions (f) at 62 per cent, (c) at 20 per cent and (e) at 12 per cent. There was a 70 per cent increase in EMG with music than with reading the score only. The EMG response to mentally conducting this Overture appeared to decay by 80 per cent between the first and second measurement periods. Mental rehearsal with music elicited 5 to 30 per cent of the actual EMG required in the task on any one day. The difference appears to be due to the depth of relaxation attained during the relaxation period prior to the mental rehearsal. These

results should be interpreted cautiously since the per cent increases have not taken into consideration the law of Initial Values.

The movement language of this conductor, represented by the EMG profile, corresponds closely to the melodic and harmonic tendencies, rhythms, textures, and varying tempi of the composition. For example:

1. There is an increase in muscular activity corresponding to the opening twelve measures of music in 'allegretto vivace' time.
2. The subsequent decrease in muscular activity immediately following the first peak corresponds to the musical pause (measure 12 of the score) and continues on a level base that is compatible with the ensuing musical section that is marked 'Allegretto', has a slower tempo and is of a more reflective and less agitated nature.
3. While the melodies and harmonies following (measures 33 to 68) are not identical to the opening 32 measures, the style, tempi and form of these measures are very similar. The graphic outline of the muscular response is very similar to the original first peak and following decrease.
4. The rise to the third peak is the 'stringendo' and the following 'allegretto'; the subsequent decrease is the sustained chord in the clarinets and bassoons (measures 72 and 73) followed by the slower more relaxed 'meno mosso' section. The work gradually increases in intensity which correponds to the increased muscular activity leading to peak four. Peak four corresponds to measure 181, 'Allegro', again followed by a decrease in muscular activity, that reflects the ensuing 'decrescendo', 'ritard' and the subsequent more relaxed and slower tempo of the 'Andante con moto' in triple metre (measure 201).
5. The remainder of the Overture shows the muscular activity also closely reflecting the qualities of the related musical section with the final increase and peaks illustrating the musical actions of the rising dynamic level from 'p' to 'ff' the increase in instrumentation to a full 'tutti', the increase in tempo ('piu vivo'), and the exciting syncopated brass passages that bring the Overture to a brilliant conclusion. (1).

Table 1 also shows that the time consumed by the mental rehearsal as compared to the actual time of the performance was identical except when mentally conducting with only the score. Much of this error could be accounted for by the data collection equipment lag time. The accuracy of MR is probably due to the conductor's considerable experience.

The per cent increase in EMG during MR appeared to represent the level of stimulation created in the neuromuscular system of the conductor under the experimental conditions. Thus, the results appear to support the psychoneuromuscular theory of mental rehearsal but do not negate other theories. The unique characteristic of the study is the closeness of the configuration of the muscle response, during MR with the taped music, to the musical characteristics of the Overture to Die Fledermaus.

Many Questions Remain

This study is a beginning in quantifying the process of MR and many questions remain to be investigated. For example, the following questions need to be addressed:

1. Are the instructions to the musician of any significance or is it sufficient to instruct him/her to spend the next five minutes mentally rehearsing?
2. Does everyone have the same ability to mentally rehearse or create equally vivid imagery?
3. Does everyone engage in the same type of MR?
4. How important is the recency of the selection that one wishes to recall?
5. How great is the intervariability in physiological response to MR?
6. How similar are an individual's repeated physiological response to MR?
7. Is there a relationship between the ability to mentally rehearse and the extent of the physiological response?
8. Is it possible to train a musician to mentally rehearse?
9. Will an increase in the quality of the mental rehearsal result in increases in performance?

Many musicians have used mental rehearsal for years and believe that it enhances their performance. This study has been a preliminary investigation into the covert responses of the body during MR and an attempt to contribute to more specific training techniques in mental rehearsal.

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TABLE 1

EMG RESPONSE DURING MR OF A CONDUCTOR

Condition	$\bar{x}$ Baseline	$\bar{x}$ MR	% Increase	$\bar{x}\Delta$ EMG	Actual Time (sec)	MR Time (sec)
With music	.15	.60	300.00	.46	470	470
Cognitive with score	1.79	2.25	20.11	.45	470	470
Conduct off the score	.26	.51	96.15	.25	470	455
Decay without music 1st 3.5 minutes	4.73	5.28	11.62	.55	210	210
Decay with music	4.38	7.1	62.10	2.69	275	275
Actual	4.38	9.26	111.42	4.88	250	—

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FINDING A WAY TO MANAGE PERFORMANCE ANXIETY: THE PROBLEMS AND PROMISES OF SCIENCE

Paul M. Lehrer

Why should scientists be interested in the problem of performance anxiety? Every performer has experienced it and knows exactly what it feels like; and with better or worse results, all performers and music teachers have devised ways of dealing with it or have resigned themselves to its inevitability. From various quarters, performers are advised to relax unneeded muscles while playing; or to study the Alexander Technique, Yoga, Zen, progressive relaxation, hypnosis, or autogenic training; to be psychoanalyzed; to take a deep breath before walking out on stage; to get in touch with one's "true self"; to think about the music and to forget about the anxiety; to learn the structure of the music and concentrate on it when nervous; to "flow with" the anxiety and to let it make the performance more exciting; to take drugs to relieve the anxiety or its symptoms; to perform more frequently—or less frequently; to worry deliberately in advance of a performance—or to try to block out all worry thoughts. The problem for a scientist is: Do these techniques all work: Are some better than others? Are some more useful than others under particular circumstances or with particular kinds of people? Or, on the other hand, is it possible that nothing can be done about the problem anyway, or that all these methods are equally useful—or useless.

This, then, is one of the promises of science: to evaluate the various approaches to dealing with performance anxiety. Another is to discover the nature of the performance anxiety. We all know what it feels like, but do we all feel it in the same way? Why do some of us have more of it than others? What precisely, is its effect on performance? How much tension is all right, and how much is too much? What is the relationship between performance anxiety, general physical and psychological health?

In this paper I will discuss scientific strategies for studying these questions; I will review some of the findings that have already been made and I will discuss both the promises that science holds for performers plagued with debilitating performance anxiety and the limits of these promises. To summarize my argument: In order to be believable, all techniques for managing performance anxiety must be studied scientifically. Perhaps some of these studies can best be done by the clinicians and music teachers who directly help people with the problems. Such "clinical" studies are rich in detail and provide important guidelines for scientists and clinicians. Innovative teachers and clinicians should feel obligated to do this type of research, if their methods are to be taken seriously. Clinical research does have limitations however, becaue of the small number of people who can be studied and the lack of experimental control. Large scale "parametric" research, on the other hand, can prove the validity of some methods, at least statistically. They too have limitations, however and methods should not be touted as "scientific" on the basis of only a handful of studies.

Clinical research. In clinical research we study a few individuals very intensively. We monitor the situations that cause their anxiety, the ways they cope with it and the ways that their anxiety is related to other important parts of their personalities, such as relationships with family, friends, religious beliefs, value systems, social skills, financial security, physical health, musical abilities and training, etc. In this kind of research, we learn to understand and perhaps, "cure" the problems in particular individuals.

Clinical research completely avoids the problem of treating individuals as statistical averages—which of course they never are; and it is a kind of investigation that can be done in any music studio.

Although clinical observation does not sound as "scientific" as the statistical and experimental research methods I will describe below, it is *just* as scientific and highly useful. Actually, scientific observation is primarily, nothing more than careful observation, measurement and description. The purpose of these is to allow others to repeat your observations by following your procedures exactly. In the words of my alcoholic high school chemistry teacher, "Siensch is accurate and shpeshific". The value of science is in the reproduceability of results, which stems from accurate observation. Thus if the clinician objectively records the performer's words, behaviors, physiological responses and carefully records what is going on in the environment—the setting, the surrounding people, the temperature, what people are doing and saying, etc.—and does this in a way that other independent observers would make exactly the same observations—then such observations are scientific. Helpful—but not at all necessary—might be to quantify the observations—so that we know *how much* a person talks, laughs, or sweats. This makes our observations more sensitive and capable of detecting critical changes and differences. Such clinical observation can be done equally well by the physician, the psychologist, or the music teacher. Without these observations, claims about the usefulness of any method cannot be taken seriously—for without them we have no idea whether the individual actually had a real problem before treatment, whether the treatment was administered correctly, whether the individual "learned" the method, or whether the method actually worked in a live performance. Although the "off-the-top-of-the-head" claims of the performer, teacher, and/or clinician are not to be completely ignored, it would be quite healthy for us to regard them all as highly suspect. Fame and fortune are always at stake here; the conflict of interest between scientific objectivity and self-promotion is too great to be ignored.

Let me give some examples of clinical research on performance anxiety. Norton, MacLean and Wachna (1978) treated a female pianist with stage fright using a technique called cognitive desensitization, a variant on the well established technique of systematic desensitization. In this technique, the woman first mapped out a hierarchy of anxiety-provoking scenes related to performing—starting with scenes that bothered her very little, perhaps like singing in a chorus; to scenes that bothered her a lot, such as having a memory slip during an important concert. She was taught a muscle relaxation technique and while deeply relaxed, she imagined the scenes, starting with the easiest scene, until she no longer felt anxious while imagining it. She also designed a series of positive self-statements that she could use while practicing and

playing the piano. Although the published report did not spell out exactly what these statements were, other clinicians and researchers have used such statements as, "I'm doing as well as I can". "I can control my feelings of anxiety". "I just thought this passage out beautifully". "I am a good and worthwhile person". "Survival is not at stake", etc. Such statements were used as substitutes for negative self-thoughts which were common in this situation. Frequent negative thoughts among performers include, "This is going to be a catastrophe", "I am going to mess up and no one will love me any more", "I might die of anxiety right here on stage", etc. After doing the desenstitization and thinking positive self-statements alone for almost two weeks in daily sessions, the subject of this study practiced giving performances for a few days in front of 5-20 people, deliberately using the relaxation techniques and self-statements she had been taught, while giving the concerts. During her concerts at home and at the university concert theater, the patient "reported that she experienced little anxiety and the memory blanks and foot shaking did not occur. During one university performance, the anxiety-evoking events were maximized (a) by the presence of a purported symphony musician and (b) by a piano with broken pedals. Even under these conditions (she) did not experience anxiety, memory blanks, or foot shaking. Before and during the performance she appeared calm and composed to the therapist and to a member of the audience who was a skilled pianist".

This type of clinical report can easily be done by any music teacher. It simply requires detailed specification of the exact technique that was applied, and of the methods used to assess the results (in this case, report of the patient, and observation of others during a concert).

I will briefly describe a more complex case that I treated several years ago. This was also of a 20-year old female pianist. Her presenting symptom was not anxiety, but cold hands—which interfered not only with her piano playing, but with living comfortably through the cold New Jersey winters. Her hands were cold both when exposed to stress and to cold. She had been diagnosed as having a disorder called "Raynaud's phenomenon" and had been treated with various drugs that dilated the blood vessels in her hands—with minimal effect. Over the course of three months, I administered twice weekly sessions of finger temperature biofeedback, during which she was taught to increase the blood flow and temperature in her fingers and hands. I also taught her autogenic training, a self-hypnotic method that helps people to regulate the physiological function of their bodies (Schultz and Luthe, 1969). Although she made much progress during the sessions, she made little progress outside. We then began talking about her relations with her parents, whom she saw as pushy and overinvested with her concert career. After she spoke with them repeatedly, honestly and assertively about their overinvolvement in her studies, they appeared to become less intrusive and her symptoms completely disappeared. I saw her a year later and she was still symptom free. She reported that she still deliberately used the biodfeedback, autogenic training and assertive skills that she had developed during therapy.

Parametric research

The problem with the clinical approach is that, despite care in taking measures that are "accurate and shpeshific", the results of clinical studies still, too often, are not reproduceable—because people are too different from each other. When the observations are taken on other individuals, too often the results differ. Hence the need for "parametric" research, in which we look at a relatively small number of measures on large numbers of people. Although this type of research only yields averages and can never completely describe the behavior of a given individual, the results of properly conducted parametric research are reproduceable. Through it we can predict the proportion of people who will (say) be affected by a specific treatment in a given way, but there will always be some margin of error—thus, as I said before, the need for a clinical "art".

Most of the research we read about is parametric research. Through it we know that treatments do appear to be effective, at least in the short term, in decreasing performance anxiety and perhaps, even in enhancing performance.

Note that I have used such qualifying words as "appear to" or "perhaps" because in truth, different measures of anxiety and slight differences in therapy procedures often produce very different results. Thus, in a study of desensitization, Wardle (1978) found that judge's ratings of performers' anxiety during performance was not affected by desensitization therapy, while Lund (1972) and Appel (1976) did find such an effect.

Other parametric research on anxiety has pointed to a number of factors that contribute to therapeutic effectiveness. We must be cautious in interpreting it, because most of it was not done on performance anxiety *per se*; but it may nevertheless give us a useful jumping-off point. I will list some of these factors.

1. **Intensity of the treatment.** Treatment carried out by a therapist or trainer tends to be more effective than treatment carried out by a tape recording or self-help manuals—although the latter procedures do produce measurable therapeutic effects. The empirical research on this question has been reviewed recently by Lehrer (1982).

2. **Modality of the treatment and of the outcome measures.** To paraphrase a colleague of mine who spoke on a similar topic, anxiety is not always anxiety is not always anxiety and relaxation is not always relaxation is not always relaxation (Schwartz, 1979). Approximately 30 years ago, when psychologists set out to measure anxiety, they tended to have a good idea of what it was that they were measuring. Anxiety, at very least, included feelings of dread, of not wanting to go on, the physiological fight or flight reaction (increased adrenaline flow, muscle tension, heart race, etc.) and avoidance of situations that made the anxiety worse. It was axiomatic that all of these symptoms were different aspects of anxiety and that all varied together (i.e., when one measure indicated high anxiety, others would also). Thus, when studying anxiety, it did not seem to matter which kind of measure was used. People tended to describe anxiety differently, depending on which measure was used—and results were often contradictory.

The results of these studies remind me of a story about three blind men who were asked to describe an elephant, after having touched only one part of it. The one who touched the trunk said that an elephant was like a long, fat snake. The one who touched the tail said an elephant is like a piece of rope. The one who touched the flank said it was like a giant wall. For elephants, however, we have independent evidence that these things are all different parts of one thing, an elephant. For anxiety, we are all like the blind men. We do not even know if there is a single such thing.

Indeed, when psychologists began to put cognitive, somatic and behavioral measures together into a single study, they found that the various measures were only minimally correlated with each other. Thus, when studying people who were afraid of snakes, the American psychologist Peter Lang (1968) found that people who said that they were the most afraid of snakes were not necessarily the ones who stayed the farthest away from a real snake when they were asked to approach it and to play with it; and neither behavioral approach to the snake nor self-report of anxiety was significantly correlated with heart rate or skin sweating when a snake was placed near the person or the person was asked to imagine a snake. So anxiety may not be like the elephant. There may be no one single thing, "anxiety". It may be different at different times and in different people.

In the many treatment studies that I have reviewed for a forthcoming book on treatment of stress (Woolfolk and Lehrer, in press), I found that three modalities of anxiety (somatic, behavioral, and cognitive) respond differently to different modalities of treatment. Somatic symptoms tend to respond best to somatic therapies; cognitive symptoms to cognitive therapies; and behavioral symptoms to behavioral therapies. Somatic therapies (such as beta blockers, biofeedback, muscle relaxation therapies, breathing exercises and certain self-hypnotic exercises) have their greatest effects on somatic measures of "anxiety", e.g., palpitations, muscle tension, tremor, nausea, sweating, etc. Cognitive therapies such as psychoanalytic psychotherapy (Horney, 1962), rational therapy (Ellis and Grieger, 1977), conditioning or teaching people to stop thinking unwanted thoughts (Rimm and Masters, 1979, pp 396-398), have their greatest effects on self-report of anxiety and well being. Behavior therapies, such as desensitization, frequent practice in performing in front of gradually more imposing audiences, instruction in how to deal with the various problems that may arise, (e.g. a poor hall, noisy audience, memory slips, tension-related technical difficulties etc.) tend to produce the most dramatic effects on behavioral measures (e.g., audibility, lack of memory slips, performing technique, etc. The split between modalities is not *absolute*. Thus there is *some* carry over from cognitive therapies to behavioral and somatic symptoms and vice versa; nor are the three kinds of symptoms *always* unconnected. Sometimes they do vary together. The *biggest* treatment effects, however, do tend to be on symptoms that match the modality of treatment (i.e., cognitive, somatic, behavioral).

Parametric research on music performance *per se* has confirmed the findings of the more general research I just cited, showing that modality—specific treatment is the most consistently effective form of therapy—although some cross-modality effects also are noted. Brantigan, Brantigan, and Joseph

(1979) reported that propranolol has more consistent effects on physiological symptoms of anxiety than on mental symptoms of anxiety during a performance; Appel (1976) found that teaching people to analyze the music they are playing has more consistent effects on number of errors in a performance than on the experience of anxiety during the performance; and Kendrick, Craig, Lawson, and Davidson found that ratings of self-efficacy as a performer improved more with cognitive therapy than with musical analysis training. Nevertheless, some indirect effects do occur for each type of technique —although they are weaker and less consistent. Thus, Brantigan et al. (1979) did find *some* effects for propranolol on reducing the psychological experience of anxiety; Lund, (1971) found that desensitization, relaxation therapy and insight therapy all produced decreases in the self-report of performance anxiety; several investigators found that cognitive therapy and desensitization both produced decreases in performance errors as well as in self-report of performance anxiety (Wardle, 1978; Appel, 1976; Sweeeny and Horan, 1982; Lund, 1972).

3. **Type of anxiety.** For the past several years, I have been giving questionnaires to performers in order to find out what kinds of performance anxiety symptoms they have. I found several clusters of symptoms, each of which appears to be unrelated to the others (Lehrer, 1981).

(1) Anxiety and fear of fear
(2) Distraction and memory problems
(3) Fearing disapproval from others
(4) Concern about performing abilities
(5) Deliberate cultivation and use of techniques for coping with anxiety during performance.

The last of these appears to be obviously less related to anxiety per se than do the others—but to repeat, *none* of the five dimensions is statistically related to any other. This suggests, therefore, that treatments for each dimension (or "kind") of performance anxiety might be quite specific and that treatments that help one type may not be as helpful for others.

4. **Number of symptoms.** The difficulty in overcoming one particular kind of anxiety does *not* appear to be related to one's age, or to the length of time that one has experienced the anxiety. It does appear to be related to the *number* of kinds of anxieties, phobias and other emotional problems that a person has. Simple behavioral techniques appear to be effective with isolated problems, but less so when people have more complex interrelated problems (Marks, 1969; Meichenbaum, Gilmore, and Fedoravicius, 1973).

There is some evidence that many people who report being anxious during a *concert* also tend to be anxious at other times—indicating that, for them, a rather complex and perhaps long term therapy may be needed. Psychologists would say that such people are high on "trait anxiety". The distinction between the terms "trait" anxiety and "state" anxiety is useful in this discussion so I will digress a moment in order to explain them. "Trait anxiety" is a stable personailty characteristic. A person who is high in trait anxiety tends to be anxious in many situations, e.g., at home, while traveling,

alone, with friends, etc. People who are high in trait anxiety tend to be reactive to all sorts of situations. Some people theorize that trait anxiety is a biological characteristic, which predisposes people to react to a variety of situations with anxiety. Other people feel that trait anxiety is produced by one's upbringing and early childhood experiences. Trait anxiety is fairly stable in adult life; i.e., under ordinary circumstances, it does not change dramatically from week to week, or month to month, although over time, various forms of psychotherapy and drug therapy are known to produce dramatic decreases in trait anxiety. State anxiety, on the other hand, refers to the kind of anxiety that is present only at a particular point in time. We all experience high state anxiety at some points in our lives.

In a recent study of mine (Lehrer, 1981) the correlation between state anxiety during a concert and trait anxiety on Spielberger's State-Trait Anxiety Inventory was found to be .61, suggesting that approximately 36% of anxiety during the performance can be explained by general anxiety. Conversely however, approximately 64% of anxiety during the performance does not appear to be related to general anxiety. Thus, although 36% of performance anxiety may require lengthy and complex treatment, 64% of performance anxiety may be amenable to treatment by specific behavioral and pedagogical techniques. The latter may be as easily carried out by the music teacher as by the psychotherapist—and perhaps even better so by the teacher, because many of these techniques require working at the instrument.

5. **Attention to the "nonspecifics" of treatment.** These generally refer to the therapeutic factors that do not seem to have anything to do with the particular technique that is being employed. Although these factors have not been systematically evaluated in studies of treating performance anxiety, we know that they are quite powerful in other respects. Sometimes these factors are lumped together and called the "placebo effect". The placebo effect should not be brushed off lightly. We want to know how to produce it, because it accounts for an uncomfortably large proportion of the therapeutic effects of most psychological techniques and psychoactive drugs. Thus, paying attention to the nonspecific factors in treatment (or in teaching) is very important. This does not mean however, that all psychoactive drugs, psychological treatment techniques and teaching techniques are nothing *but* placebos. Most of the techniques that I describe in this paper have been compared empirically with various placebo conditions, in which the 'nonspecific' factors are all present but the specific techniques are not—and all these therapies are known to be more powerful than placebo conditions alone.

A very relevant form of placebo condition—relevant because it is not only very believable, but because it is a method that actually is widely used by music educators and can thus ethically be used as a "control" or "placebo" condition—is training in musical analysis of the selection being played. The rationale for musical analysis training as a treatment of performance anxiety is that a better understanding of the structure of the music will increase the performer's sense of control over the situation and thereby decrease in anxiety during a performance. Appel (1976) found desensitization to have produced greater reductions in self report of anxiety than the musical analysis

condition, and than a no treatment condition; although in this case, musical analysis training was better than no treatment at all. Only desensitization produced a significant decrease in heart rate during the performance: although only musical analysis training produced a decrease in number of errors, indicating that musical analysis does actually have a specific effect (though not on anxiety per se), compared with no treatment at all. More recently Sweeny and Horan (1982) compared musical analysis training with a relaxation technique called cue-controlled relaxation and found that relaxation produced greater decreases in anxiety, in performance errors and heart rate during a performance, than did musical analysis training. In this study, musical analysis training produced no measurable improvements in any measure, although subjects "believed in it" as much as they did in the other two techniques.

One of the important often nonspecific effects appears to be expectancy (Frank, 1978). The results are always better when therapy is delivered by someone who is convinced of the technique and who puts it across in a way that convinces the patient that it will work. The charisma of the teacher or therapist may be particularly important here; although the exact personality characteristics of the trainer that maximize this effect are not well studied.

Not only do the expectancies of the client and therapist (or student and teacher) affect the outcome of various techniques, but (unfortunately), so do the expectancies of the experimenters. It is well known that, more often than they should, experiments yield findings that are consistent with the hypotheses of the experimenters (Rosenthal, 1969). This is only very rarely due to intentional fudging of data, despite the publicity that has been given to this type of fraud recently. Most often it is caused by unintentional errors and slips, which cumulatively can sway the results of an entire experiment. This decidely does *not* imply that all research is hopelessly biased or that the whole enterprise should be abandoned. It does imply that *multiple* studies must be done on each question and that the hypotheses of the experimenters must be reported and taken into account when the data are interpreted.

Another important nonspecific factor probably is the ability of the trainer to master his or her own stress and to be a warm individual who gives of him or herself. Thus various relaxation procedures are known not to be teachable by persons who are unable to relax themselves; nor can they be effectively taught by therapists who are cold, distant and "professional", rather than warm and friendly (Taub, 1977).

Durability of effects. Those techniques that have been extensively evaluated generally have been examined only with respect to their short-term effects. We know however, that it is the long-term rather than short-term effects of a technique that will make it most useful. How helpful would a technique be if it helped through a single performance, but then seemed to lose its effect; or worse still, produced long-term side effects that were worse than the original symptoms? It is expensive and very time consuming to do research on long-term effects of various therapies and in the academic world, there are many incentives for doing short-term research and few for long-term research (i.e., one can get a promotion and tenure in a psychology department in the U.S. more easily by doing many short-term studies than by doing fewer long-term studies, which may come to fruition only some years after the tenure decision is to be made).

Let me illustrate this point by describing an interesting study by Lavallée, Lamontagne, Pinard, Annable, and Tetreault (1977). They studied the widely used minor tranquillizer best known by its trade name valium and they compared it with a technique of voluntary muscle relaxation. They studied anxiety neurotics i.e., people who suffer from frequent panic attacks, which seem to come as if from nowhere and make the sufferers feel that they are about to die imminently; or at very least, appear terribly awkward and foolish in front of others. Volunteers for this study were assigned randomly either to a group that received valium, or to a group that received a placebo pill. The doctors giving the medicine did not know which kind of pill they were administering to each subject, so they could not bias the study by communicating their own expectations to the subjects. Half of the subjects in each drug group also were administered progressive relaxation. The other half were told to relax regularly, but they received no special training. After eight weeks of treatment, both treatments seemed to work. Those who had been taught to relax had fewer anxiety symptoms than those who had not and those who had been administered valium had fewer anxiety symptoms than those who had been administered the placebo. Oddly enough, the two treatments did not interact: i.e., those who had been administered both of the active treatments did not do better than those who had been administered only one. So far, this appears to have been an interesting, but not earthshaking demonstration of the short-term effects of two widely used treatments. The most interesting results from the study however, were obtained one year after the study was over. After leaving the study, subjects went back to their own doctors and received whatever treatment they or their doctors felt was best for them. They still did not know whether they had been in an active treatment group or in a control group. Lavallée, *et al* found that after a year, subjects who had received valium during the 8-week study were more anxious than subjects who had received the placebo, that they took more drugs of various sorts in order to combat their anxiety and that they used their relaxation methods less. Thus, although valium appeared to help people over the short-run, it appeared to hurt them over the long-run, by making them more drug-dependent and less resourceful in using their own non-drug self-control strategies. This appeared to produce higher levels of anxiety at a year's time.

Might the same be true for treatment of performance anxiety by propranolol; or, in fact, by the Alexander technique, by relaxation therapy, by cognitive therapy, or any other technique? The disturbing fact is, we just do not know! The studies have not been done.

Desirability vs Effectiveness of a Treatment Technique

Science can uncover facts, but it cannot make choices. Not all choices are based on fact. Such factors as pleasantness of a choice, expense and ethics, may be more critical. Is relaxation preferable to propranolol for controlling performance anxiety? No study has yet been done on this, as far as I know.

Suppose that studies found them to be equivalently effective in reducing performance anxiety. Relaxation therapy is certainly more expensive, as much as ten times more. Does this mean that propranolol is better? Science can tell us all the specific short-term and long-term effects of each intervention on the quality of performance, various self-report measures of anxiety and various physiological measures, but science cannot answer this question for us. It is not a question for scientists, physicians, psychologists, or other technical experts—but for experts on morality and for all of us as we make value decisions. Performers should *not* look only to scientific experts to make these decisions. We are not qualified to do this.

CONCLUSION

The promise of science is reproduceable results. Scientific work depends on well-described and accurately measured observations. These measures can easily be taken by clinicians and teachers. Any careful, sensitive, trained observer can document changes in tonal quality; or can comment about ease of performance, willingness to perform more, etc. When we use an approach to help or to teach people, it is important that we document how each instruction produces specific effects. Dramatic claims and testimony from famous performers are generally not very convincing, unless backed up by such careful and copious observation. Once a technique has been repeatedly validated by clinical research, then parametric research is absolutely necessary in order to test the reproduceability of the effect, the size of the effect, and the contribution of "nonspecific" or "placebo" factors to the overall effect.

Thus, if we are advocating a technique of differential relaxation at the piano keyboard, or the Alexander technique, or autogenic training, or slow deep breathing, etc., it is incumbent upon us to prove that they actually work. At best, parametric research should be done and groups of subjects should randomly be assigned either to get a special technique, or not. Those not given the technique should get some other special treatment which, although perhaps beneficial, might be expected to have at best, very different kinds of effects (e.g., more training in music theory, special readings about great performers, etc.) Multiple measures of performance anxiety and quality of performance should be taken and long term effects measured. If this is not practical (as it probably is not, unless you have a research grant), at least record the student's anxiety level (ask an individual to rate anxiety on a scale of 0-100), tone quality, frequency of performance, etc., and keep good records on each student, so you can go over them afterward and see which techniques seemed to have had the best effects.

Even after several apparently well-done parametric studies have appeared to validate a technique however, we still may not be convinced of its effectiveness. Experimenter bias may lurk as a confounding factor. Also, as I have described above, there are many forms of anxiety. A technique may have a beneficial effect on one kind, but no effect on another. No study can include all measures. Also, from study to study, techniques of teaching or therapy tend to vary slightly, as do the populations on whom the methods are tested and as do the personalities of the instructors or therapists. Thus, *many* studies are needed of each technique to show the various conditions under which the technique does and does not work, on whom and administered by whom. No single study can ever be considered conclusive in this field. Yet, in the whole field of tension in the performance of music, there now are fewer than a dozen published parametric studies. Therefore, beware of people who say that their techniques are "scientific"—on the basis of only one or two studies. Science is a *process*, not a judge or arbiter. On the other hand, we cannot confine our teaching or therapy to those techniques that have been well validated, because if we did so, we would have almost no tools at all, especially at this early stage. Although scientific findings may be helpful as guides to the teacher or therapist, therapy and teaching (and in fact, the practice of medicine) still are arts. Although scientific technology can provide useful tools and although all techniques can *only* be validated by use of scientific method, nevertheless, science can be a blinder as well as a boon, unless we see it in its proper place.

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FOOTNOTES

1. Note that one "nonspecific" that I did *not* mention is professional degree or discipline. There is no evidence that behavioral techniques such as progressive or differential relaxation, in vivo desensitization, thought stopping, etc. are more effective when carried out by a psychologist or other health professional than when carried out by a music teacher. Indeed, common sense suggests that music teachers might do better, because they can integrate therapeutic interventions with instrumental technique, or with performance practice.

2. The author is indebted to Phyllis Lehrer and Samuel Lehrer for their helpful comments on earlier drafts.

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